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2687. Proposed by N. P. PANDYA, Sojitra, India.

An ellipse intersects a parabola in A and B, and the tangents at A and B to the parabola meet at T. The center C of the ellipse lies within the space enclosed by the parabola and the tangents. Draw a third tangent to the parabola such that C may be the centroid of the triangle formed by the three tangents.

2688. Proposed by FRANK IRWIN, University of California.

With four quantities, a_1, a_2, a_3, a_4, we may, without changing their order, form the following complex fractions:

$$\dfrac{a_1}{\dfrac{a_2}{\dfrac{a_3}{a_4}}} \qquad \dfrac{a_1}{\dfrac{\dfrac{a_2}{a_3}}{a_4}} \qquad \dfrac{\dfrac{a_1}{a_2}}{\dfrac{a_3}{a_4}} \qquad \dfrac{\dfrac{a_1}{\dfrac{a_2}{a_3}}}{a_4} \qquad \dfrac{\dfrac{\dfrac{a_1}{a_2}}{a_3}}{a_4}$$

But these have not all different values; the first and fourth are equal.

Determine how many different rational functions of the quantities a_1, a_2, $\cdots$ a_n may be obtained in this way, and which can be represented in more than one way as a complex fraction of the above kind, and which in only one way.

Restatement of 434 (Calculus). Proposed by E. W. CHITTENDEN, Champaign, Ill.

Evaluate $\int_0^1 f(x)dx$ where

$$f(x) = \sum_{n=1}^{n=\infty} \frac{\text{sgn}\,(x - x_n)}{2^n}\,.$$

The function $\text{sgn}\,x = -1, 0, +1$ according as x is negative, zero or positive. The numbers x_n form the series

$$\tfrac{1}{2}, \tfrac{1}{4}, \tfrac{3}{4}, \tfrac{1}{8}, \tfrac{3}{8}, \tfrac{5}{8}, \tfrac{7}{8}, \cdots$$

for which the general formula is $x_n = (2h + 1)/2^k$, where k is the greatest integer such that $2^{k-1} \leqq n$ and $h = n - 2^{k-1}$.

Note. This problem is reprinted because of a misprint in the original statement and also because of a lack of definiteness in the definition of the series of values x_n. An inquiry has also been received in regard to the origin of the notation "sgn x." This notation seems to be due to Kronecker; cf. Werke, Vol. II, p. 500.

SOLUTIONS OF PROBLEMS.

487 (Algebra). Proposed by WILLIAM HOOVER, Columbus, Ohio.

Show in two ways that 0.5623 is not a root of $(1 - m)e^m = 2e^{-1}$, e being the Napierian base. Find the value of m, and test the result in two ways.

SOLUTION BY E. E. WHITFORD, New York City.

Taking logarithms of both sides, we have

$$\log\,(1 - m) + (m + 1)\log e = \log 2, \quad \text{or} \quad \log\,(1 - m) = \log 2 - 1 - m.$$

Substituting .5623 for m,

$$\log .4377 = .6931 - 1 - .5623 = 9.1308 - 10.$$

But this is false since $\log .4377 = 9.1733 - 10$. Or, from $(1 - m)e^{m+1} = 2$, on taking $m = .5623$ we have $e^{1.5623} = 4.57$. But this is false, since $4.57 = e^{1.5195}$. One value of m is .5936 approximately; this checks by both the above methods. We may also have $m = -1$.

Also solved by C. E. FLANAGAN and EDWARD H. WORTHINGTON.